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TITLE: Surface mount resin-sealed semiconductor device - has adhesive layer
whose rate of moisture absorption is smaller than that of resin for sealing
NoAbstract

PATENT-ASSIGNEE: HITACHI LTD[HITA]

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SURFACE MOUNT RESIN SEAL SEMICONDUCTOR DEVICE ADHESIVE LAYER RATE MOIST ABSORB
SMALLER RESIN SEAL NOABSTRACT

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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the plastic-molded-type semiconductor device of the surface mount method exposed to an elevated temperature at the time of mounting which related to the plastic-molded-type semiconductor device, especially was fixed on the die pad through the glue line.
[0002]
[Description of the Prior Art] As a method of fixing a semiconductor device on a die pad, the method using the eutectic alloy of Au-Si, solder, adhesives, etc. is learned like a publication for example, electronic material, 20 (11), 31, and (1981). However, since the method using an eutectic alloy is exposed to an elevated temperature in case it fixes a semiconductor device to a die pad, an element receives a damage, and a property changes and the method using solder has the problem to which the solder and solder ball which evaporated disperse, it adheres to an electrode etc., and degradation of corrosion, an open circuit, etc. takes place. Then, generally the method using adhesives, such as an epoxy resin which blended present Ag powder etc., is used.
[0003]
[Problem(s) to be Solved by the Invention] Small and the demand which it thin-shape-izes [demand] and raises packaging density are also increasing [the electronic-intelligence device] the miniaturization and the semiconductor device incorporated in a device as it thin-shape-izes. Although the method (pin insertion method) which a printed circuit board is made to penetrate the lead of a semiconductor device conventionally, and dips and solders a lead portion to a solder tub was used in order to fill this demand, the lead of a semiconductor device is bent to J type etc. now, and the method (surface mount method) which solders to the front wiring of a printed circuit board by heating by infrared radiation etc. is becoming in use. It is advantageous to mounting a semiconductor device in printed circuit board both sides raising eye a possible hatchet and packaging density by the surface mount method. On the other hand, by the surface mount method, since the whole semiconductor was heated, when soldering to a semiconductor device [having absorbed moisture], in the die-pad circumference, the moisture which absorbed moisture expanded rapidly and there was a problem that a crack arose in a resin layer. this invention aims at supplying the plastic-molded-type semiconductor device which a crack etc. does not generate even if it performs the surface mount after moisture absorption in the plastic-molded-type semiconductor device which closes this for a semiconductor device with a resin after connection with a leadframe by fixation and the bonding wire through adhesives on a die pad.
[0004]
[Means for Solving the Problem] In order to solve the aforementioned technical problem, as a result of examining many things about the relation between many properties, such as composition of adhesives, a moisture absorption, a glass transition temperature, and coefficient of thermal expansion, and the rate of crack initiation at the time of a surface mount, between the moisture absorption of a glue line, and the rate of crack initiation, this invention persons found out that there was correlation and resulted at this invention. That is, in this invention, a semiconductor device is fixed through a glue line on a die pad,

this semiconductor device is connected with the leadframe by the bonding wire, and the aforementioned glue line is taken as the plastic-molded-type semiconductor device characterized by being smaller than the resin with which the moisture absorption closed this in the semiconductor device with which these are closed by synthetic resin. The synthetic resin which closes the aforementioned semiconductor contains one or more kinds chosen from the epoxy system resin, the phenol system resin, and the polyimide system resin. Moreover, as for the glue line which fixes a semiconductor device on a die pad, it is better than a closure resin that it is the structure which sank in or applied the resin to the base material of a low moisture absorption.

[0005] And it can consider as the method of making the moisture absorption of a glue line small, and the technique of reducing the pitch of a glue line can be used by sinking in applying a resin to base materials of low moisture absorption, such as glass fabrics and a metallic foil, or blending bulking agents, such as a silica, with a resin. a softening temperature like thermosetting resin, such as a bisphenol type epoxy resin, an epoxy resin which has a biphenyl frame, an epoxy resin which has a naphthalene frame, a novolak type epoxy resin, and polyimide resin, phenol resin, or a phenoxy resin and a polyether type amide resin as a resin used for a glue line is independent respectively in the thermoplastics in the range which is 150-300 degrees C -- or two or more kinds can be mixed and it can use There is a possibility that a glue line may soften in heating by the subsequent resin-seal process, an element may move, and a wire lead may cut if a softening temperature is lower than this in the case of thermoplastics, and an element receives a damage with heat at the process which fixes a semiconductor device on a die pad if a softening temperature is higher than this.

[0006] before the glue line used for this invention fixes an element to a die pad -- the shape of the shape of a paste, and a film -- although in which state is sufficient, after fixing a semiconductor device to a die pad, in order to make connection between an element and a leadframe by the bonding wire, a glue line needs to be maintained at a flat surface, and the shape of a film is advantageous Moreover, it is also possible to perform application dryness for a resin on a semiconductor device rear face or a die-pad front face beforehand using a solvent etc., to make a glue line form by solvent removal, and to use for fixation of a die pad and a semiconductor device after that. Furthermore, it is necessary to make it a semiconductor device not move at the time of wire BONDIGU, and it needs to carry out adhesive strength of a die pad to a semiconductor device beyond the sticking-by-pressure force of wire BONDIGU.

[0007]

[Function] The die pad and the semiconductor device were fixed using various glue lines, the plastic-molded-type semiconductor device was created by transfer molding after wire BONDIGU, it heated by fixed conditions on the same conditions as the time of an after [moisture absorption] surface mount, and the existence of crack initiation was investigated. Moreover, the plastic-molded-type semiconductor device after an examination was disassembled, and it investigated how a crack would occur. Consequently, when the moisture which absorbed moisture in the glue line for the crack at the time of a surface mount making a die pad and a semiconductor device fix heats and expanded rapidly, it became clear that a semiconductor device and a die pad can extend, exfoliation progresses between a die pad/resin further, and a crack occurs. When the glue line of a larger moisture absorption than the moisture absorption of a closure resin is used, if a plastic-molded-type semiconductor device absorbs moisture, from a closure resin portion, moisture tends to collect on the glue-line section, at the time of mounting, this moisture will expand and a crack will occur. However, since moisture does not collect on a glue-line portion when the glue line of a moisture absorption smaller than closure material is used, even if it is heated by mounting examination, there is almost no expanding moisture and it is hard coming to generate a crack.

[0008] Furthermore, even if moisture absorptions, such as adhesives which constitute a glue line, are small, when it dissolves adhesives using a solvent and a glue line is made to form, the defect to which the solvent evaporated in the glue line by heating remains in the process which fixes a semiconductor device on a die pad. When the semiconductor device which carried out the resin seal in such the state is made to absorb moisture, the moisture which absorbed moisture to a part for this defective part collects,

this moisture evaporates and expands by heating at the time of mounting, and a crack is caused. Then, in case the moisture absorption of a glue line is smaller than the moisture absorption of a closure resin and a semiconductor device is fixed to a die pad in such a plastic-molded-type semiconductor device, it is made for defects, such as a void, not to arise. It is able to make it, even if moisture cannot collect on a die pad and a semiconductor device interface easily even if it makes it absorb moisture and it is heated at the time of a surface mount, since a glue line does not have a defect and the moisture absorption of a glue line becomes smaller than a closure resin, when a die pad and a semiconductor device are fixed using the glue line of this invention for a crack not to occur.

[0009]

[Example] Hereafter, this invention is concretely explained using an example.

2 [example 1 epoxy denaturation polybutadiene 30g, 20g of bromine content styrene resins, 50g of ** fluorine bismaleimide resins, and Benzoguanamine / 0.8g and 0.5g], the 5-dimethyl -2, and 5-di-tert-butyl peroxide hexyne -3. Dissolved in the partially aromatic solvent (methyl-isobutyl-ketone 70g and dimethylformamide 30g), it was made to sink into glass fabrics with a thickness of 20 micrometers, the solvent was removed at the temperature of 130-150 degrees C, it cut in the size equivalent to a semiconductor device, and the film for glue-line formation was created. Using this adhesive film, fixed the 9x15mm semiconductor device with the die pad at 130 degrees C, heated at 220 more degrees C for 120 minutes, it was made to harden completely, and the plastic-molded-type semiconductor device was created [by the bonding wire] after connection using the encapsulant of an epoxy resin system by transfer molding with the leadframe. Furthermore, it was heated after moisture absorption on conditions with a% [of humidity] of 85, and a temperature of 85 degrees C, this plastic-molded-type semiconductor device was heated on the conditions for 90 seconds by 265 degrees C, and the existence of crack initiation was investigated. The result is shown in Table 1.

[0010] The example 2 phenoxy resin was dissolved in the methyl isobutyl ketone, application afterbaking dryness removed the solvent at the semiconductor device rear face, and the glue line was formed in it. The semiconductor device and the die pad were fixed for this at about 250 degrees C, and the plastic-molded-type semiconductor device was created by transfer molding after connection with the leadframe by the bonding wire. The reliability trial was performed for this on the same conditions as an example 1. The result is shown in Table 1.

[0011] 70g [of example 3 phenoxy resins], 20g [of novolak type epoxy resins], 10g [of phenol novolak resins], and triphenyl phosphine 0.1g was dissolved in the 100g methyl isobutyl ketone, application afterbaking dryness removed the solvent at the semiconductor device rear face, and the glue line was formed in it. After fixing the semiconductor device and the die pad for this at about 150 degrees C and performing hardening for 120 minutes at 180 more degrees C, it connected with the leadframe by the bonding wire, and the plastic-molded-type semiconductor device was created by transfer molding. The reliability trial was performed for this on the same conditions as an example 1. The result is shown in Table 1.

[0012] Dissolved 70g [of example 4 phenoxy resins], 20g [of novolak type epoxy resins], 10g [of phenol novolak resins], and triphenyl phosphine 0.1g in the 100g methyl isobutyl ketone, it was made to sink into glass fabrics with a thickness of 20 micrometers, the solvent was removed at the temperature of 150 degrees C, it cut in the size equivalent to a semiconductor device, and the film for adhesion was created. Fix a die pad and a semiconductor device at 150 degrees C, and the glue line was made to form using this adhesive film, and after heating for 120 minutes and making it harden completely at 180 more degrees C, the reliability trial was performed after creating a plastic-molded-type semiconductor device on the same conditions as an example 1. The result is shown in Table 1.

[0013] 70g [of example 5 phenoxy resins], 20g [of novolak type epoxy resins], 10g [of phenol novolak resins], and triphenyl phosphine 0.1g was dissolved in the 100g methyl isobutyl ketone, it applied on the glass plate which carried out mold release processing, and the adhesive film with a thickness of 20 micrometers was created from the glass plate after solvent removal. Fix a die pad and a semiconductor device at 150 degrees C, and the glue line was made to form using this adhesive film, and it heated at 180 more degrees C for 120 minutes, and hardened completely, and the reliability trial was

performed after creating a plastic-molded-type semiconductor device on the same conditions as an example 1. The result is shown in Table 1.
[0014] The 4g methyl ethyl ketone was blended with 10g of example of comparison 1 bisphenol A type epoxy resins at 1g silver dust, 4, and 4'-diamino diphenylmethane 3g, and the paste for adhesion was created. Fix a die pad and a semiconductor device at 150 degrees C, and made the glue line form using this adhesion paste, and heated at 180 more degrees C for 120 minutes, it was made to harden completely, and the reliability trial was performed after creating a plastic-molded-type semiconductor device on the same conditions as an example 1. The result is shown in Table 1.
[0015] 2 [example of comparison 2 epoxy denaturation polybutadiene 30g 20g of bromine content styrene resins, 50g of ** fluorine bismaleimide resins, and Benzoguanamine / 0.8g and 0.5g], the 5-dimethyl -2, and 5-di-tert-butyl peroxide hexyne -3 were mixed with methyl-isobutyl-ketone 20g and dimethylformamide 10g, and the paste for adhesion was created. Using this adhesion paste, fixed the die pad and the semiconductor device at 150 degrees C, heated at 180 more degrees C for 120 minutes, it was made to harden completely, and the reliability trial was performed after creating a plastic-molded-type semiconductor device on the same conditions as an example 1. The result is shown in Table 1.
[0016] Furthermore, the glue line was formed between 1mm in thickness, and 20mmx20mm melting quartz glass by the same method as examples 1-5 and the examples 1 and 2 of comparison, and it asked for the moisture absorption from weight change after moisture absorption on conditions with a% [of humidity] of 85, and a temperature of 85 degrees C. Furthermore, the resin for closure of an epoxy resin system was also made to absorb moisture on the same conditions, and computed the moisture absorption. Those results are shown in Table 1. It became clear that it is hard to generate a crack at the time of a surface mount that moisture cannot collect [what has the moisture absorption of a glue line there are few defects of a glue line than this table, and smaller than a closure resin] easily between die-pad semiconductor devices.
[0017]
[Table 1]

【表1】

吸湿時間（時間）		実施例1	実施例2	実施例3	実施例4	実施例5	比較例1	比較例2	封止樹脂
48	吸湿率（%）	0.05	0.08	0.10	0.09	0.10	0.10	0.11	0.11
	クラック発生率（%）	0	0	0	0	0	0	0	—
72	吸湿率（%）	0.09	0.15	0.16	0.15	0.17	0.21	0.28	0.21
	クラック発生率（%）	0	0	0	0	0	5	10	—
168	吸湿率（%）	0.12	0.18	0.21	0.20	0.21	0.35	0.37	0.32
	クラック発生率（%）	0	0	0	0	0	15	30	—
240	吸湿率（%）	0.15	0.30	0.33	0.32	0.29	0.49	0.51	0.36
	クラック発生率（%）	0	0	1	1	2	70	100	—
336	吸湿率（%）	0.16	0.31	0.35	0.34	0.34	0.55	0.64	0.38
	クラック発生率（%）	0	2	8	2	3	100	100	—

[0018]
[Effect of the Invention] Since this invention lessens the defect of the glue line which fixes a die pad and a semiconductor device as explained above, it is possible for moisture to be unable to collect easily between a die pad and a semiconductor device, and for after moisture absorption to raise the crack-proof nature at the time of a surface mount in a plastic-molded-type semiconductor.

[Translation done.]

* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It is the plastic-molded-type semiconductor device characterized by being smaller than the resin with which, as for the aforementioned glue line, the moisture absorption closed this in the semiconductor device with which a semiconductor device is fixed through a glue line on a die pad, this semiconductor device is connected with the leadframe by the bonding wire, and these are closed by synthetic resin.
[Claim 2] The synthetic resin which closes the aforementioned semiconductor device is a plastic-molded-type semiconductor device according to claim 1 characterized by containing one or more kinds chosen from the epoxy system resin, the phenol system resin, and the polyimide system resin.
[Claim 3] The glue line which fixes a semiconductor device on a die pad is a plastic-molded-type semiconductor device according to claim 1 characterized by being the structure which sank in or applied the resin to the base material of a low moisture absorption rather than the closure resin.
[Claim 4] The aforementioned base material is glass fabrics, a metallic foil, and a plastic-molded-type semiconductor device according to claim 3 characterized by using one or more kinds chosen from the carbon cross.
[Claim 5] The plastic-molded-type semiconductor device according to claim 1 with which the glue line which fixes a semiconductor device on a die pad is characterized by the bird clapper from the glue line containing thermoplastics of 150-300 degrees C of one or more kinds of softening temperatures.